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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/880,733	06/12/2001	Tasao Soga	16869S-027500US	4951

20350 7590 12/31/2003

TOWNSEND AND TOWNSEND AND CREW, LLP
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EXAMINER


ANDUJAR, LEONARDO

ART UNIT	PAPER NUMBER
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2826

DATE MAILED: 12/31/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.		Applicant(s)	
	09/880,733		SOGA ET AL.	
	Examiner		Art Unit	
	Leonardo Andújar		2826	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 10 November 2003.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-3, 10 and 14-26 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-3, 10, 14, 15, 17, 18, 20, 22, 23, 25 and 26 is/are rejected.
- 7) ☒ Claim(s) 16, 19, 21 and 24 is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. §§ 119 and 120

- 12) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
a) ☒ All b) ☐ Some * c) ☐ None of:
1. ☒ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
* See the attached detailed Office action for a list of the certified copies not received.
- 13) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application) since a specific reference was included in the first sentence of the specification or in an Application Data Sheet. 37 CFR 1.78.
a) ☐ The translation of the foreign language provisional application has been received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121 since a specific reference was included in the first sentence of the specification or in an Application Data Sheet. 37 CFR 1.78.

Attachment(s)

- | | |
|---|---|
| 1) <input type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413) Paper No(s). _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO-1449) Paper No(s) <u>10 & 11/03</u> | 6) <input type="checkbox"/> Other: |

DETAILED ACTION

Election/Restrictions

1. Applicant's election of embodiment 12 in Paper No. 12 is acknowledged. Because applicant did not distinctly and specifically point out the supposed errors in the restriction requirement, the election has been treated as an election without traverse (MPEP § 818.03(a)).

Acknowledgment

2. The amendment filed on 09/29/2003, in response to the Office action mailed on 06/04/2003 has been entered. The present Office action is made with all the suggested amendments being fully considered. Accordingly, pending in this Office action are claims 1-3, 10 and 14 -26.

Priority

3. Receipt is acknowledged of papers submitted under 35 U.S.C. 119(a)-(d), which papers have been placed of record in the file.

Claim Rejections - 35 USC § 103

4. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

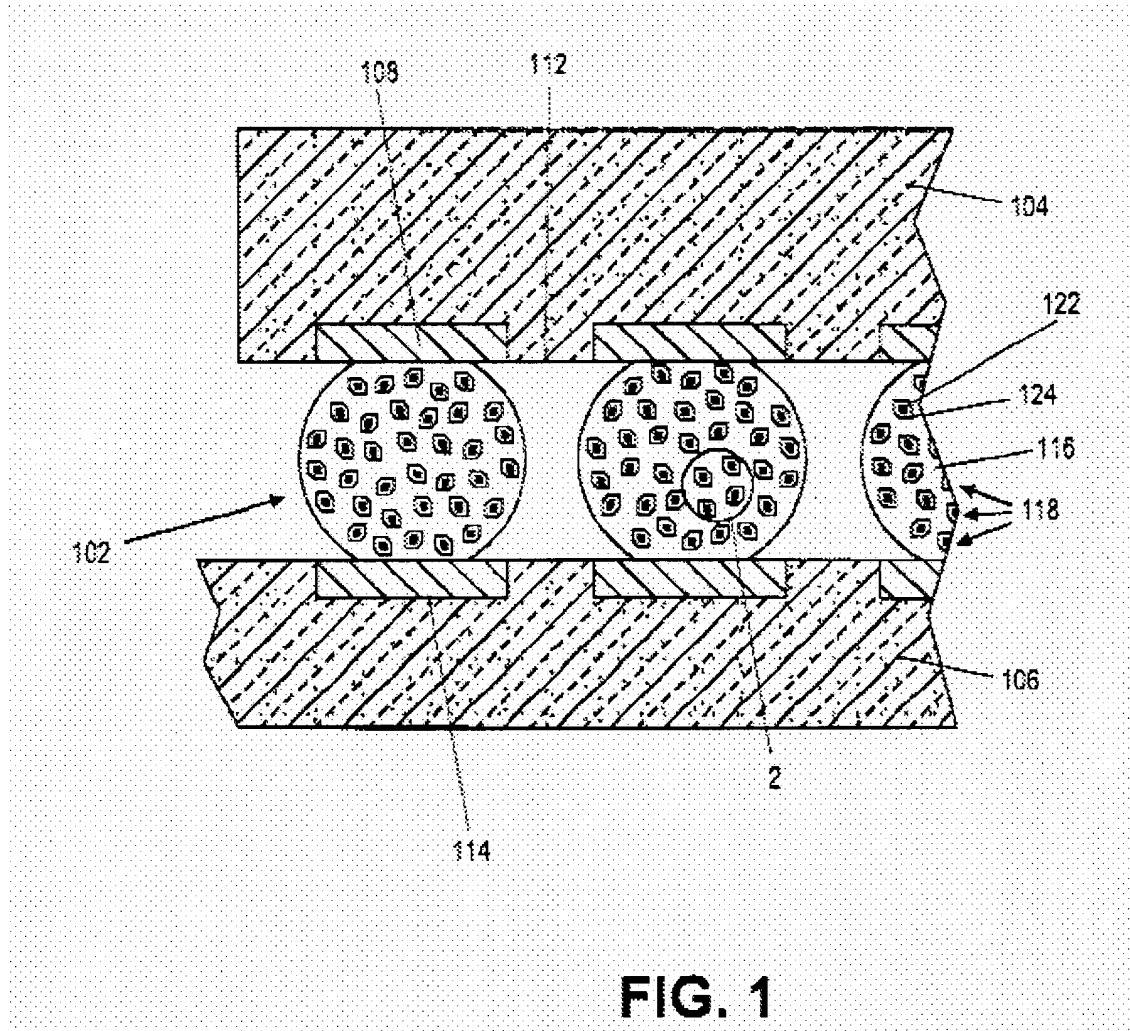
(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

5. This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of

the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

6. Claims 1-3 and 17-19 are rejected under 35 U.S.C. 103(a) as being unpatentable over Koning (US 6,365,973 cited by applicant) in view of lino et al. (US 6,207, 259).

7. Regarding claim 1, Koning (e.g. figs. 1 and 2) shows an electronic device comprising a semiconductor device 104 provided with pads 108 and a substrate 106 provided with pads 114 on which the semiconductor device is mounted. Also, Koning shows that the semiconductor device's pads and the substrate's pads are bonded by junctions 102. The junctions include Cu balls 124 bonded to each other by Cu-Sn compounds 116 (col. 3/lis. 31-34).



Although Koning does not list all possible Cu/Sn intermetallic compounds it is a scientific fact that Cu/Sn intermetallic compounds include Cu_3Sn_6 and/ or Cu_6Sn_5 . For example, lino teaches that Cu_3Sn_6 and $\text{Cu}_6\text{Sn}_5\text{C}$ are Cu/Sn intermetallic compounds. According to lino a $\text{Cu}_6\text{Sn}_5/\text{Cu}_3\text{Sn}_6$ ratio of less than 0.65 improves the electric and heat resistance properties of the alloy (col. 3/ll. 63-col. 4/ll. 34). It would have been obvious to one of ordinary skill in the art at the time the invention was made to make the junctions 116 disclosed by Koning having intermetallic compounds in a ratio

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($\text{Cu}_6\text{Sn}_5/\text{Cu}_3\text{Sn}_6$) of less than 0.65 in order to improve the electric and heat resistance properties of the alloy as taught by lino.

8. Regarding claim 2, Koning the mixture may include In, Zn and Bi (col. 3/lis. 31-34).

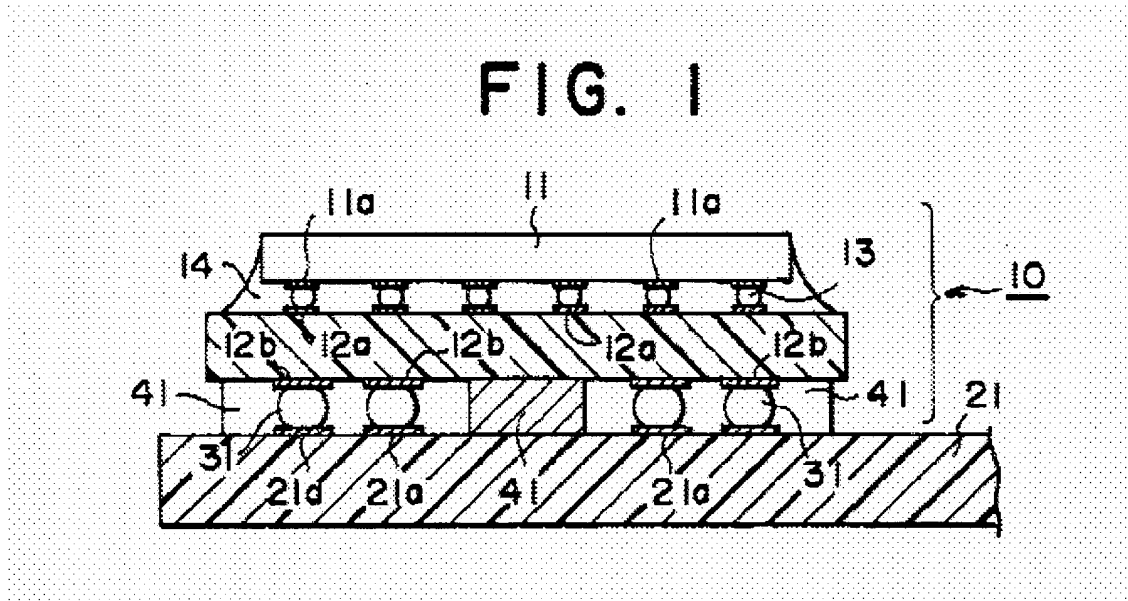
9. Regarding claim 3, Koning discloses that the junction has plastic balls e.g. copper balls. Note that copper is considered a plastic material because it exhibits some degree of plasticity.

10. Regarding claims 17 and 18, Koning discloses that the junctions are formed by Cu balls and solder balls such as Sn balls (col. 13/lis. 31-34).

11. Regarding claim 19, Koning discloses that the solder may include one of In, Zn or Bi (col. 13/lis. 31-34).

12. Claims 10, 14, 22, 23, 25 and 26 are rejected under 35 U.S.C. 103(a) as being unpatentable over Iwasaki (US 5,834,848) in view of Koning (US 6,365,973 cited by applicant) further in view of lino et al. (US 6,207, 259).

13. Regarding claim 10, Iwasaki (e.g. fig. 1) shows an electronic device comprising a semiconductor device 11 having pads 11a, a first substrate having pads 12a on which the semiconductor device is mounted and a second substrate 21 provided with pads 21a on which the first substrate is mounted. Also, the pads of the semiconductor device are bonded to the pads of the first substrate through solder bumps 13 and the pads of the first substrate are bonded to the pads of the second substrate by solder bumps 31.

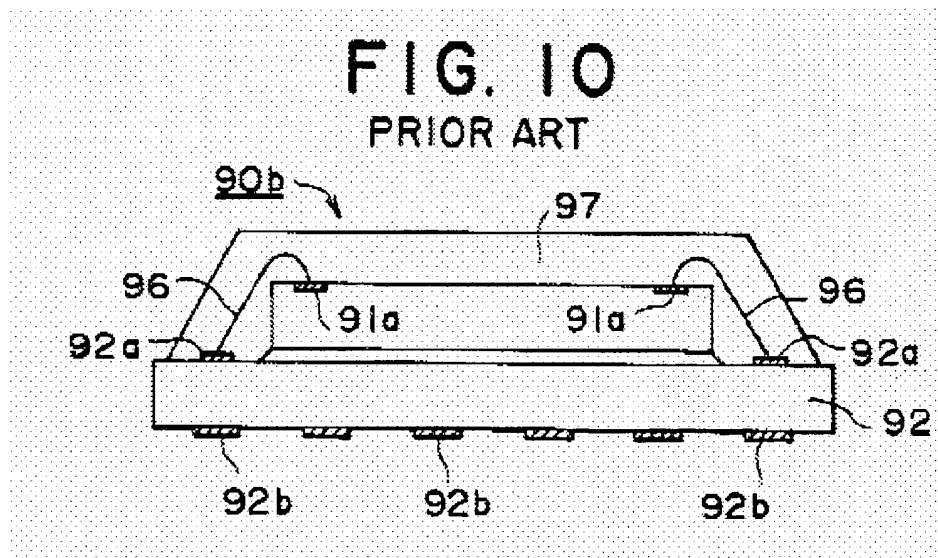


Iwasaki does not suggest that the bumps (13, 31) can be made from Cu balls bonded to each other by a Cu-Sn compound such as Cu_6Sn_5 or from a Sn-Ag base solder, a Sn-Ag-Cu base solder or a Sn-Cu base solder. Koning (e.g. fig. 1) discloses an electronic device including junction bumps 102. This junction balls include Cu balls 124 bonded to each other by a Cu-Sn 116 (col. 3/lis. 31-34). Alternatively, the solder may include a Sn-Ag base solder, a Sn-Ag-Cu base solder or a Sn-Cu base solder. This type of junction provides a lower coefficient of thermal expansion CTE which results in a lower thermal mismatch, less internal stress during thermal cycling, and therefore a more reliable attachment (col. 3/lis. 17-19). Although Koning does not list all possible Cu-Sn intermetallic compounds it well known in the art that Cu/Sn intermetallic compounds include Cu_3Sn_6 and/ or Cu_6Sn_5 . For example, Iino teaches that Cu_3Sn_6 and $\text{Cu}_6\text{Sn}_5\text{C}$ are the Cu-Sn intermetallic compounds. According to Iino, a $\text{Cu}_6\text{Sn}_5/\text{Cu}_3\text{Sn}_6$ ratio of less than 0.65 improves the electric and heat resistance properties of the alloy (col. 3/ll. 63-col. 4/ll. 34). It would have been obvious to one of ordinary skill in the art at

the time the invention was made to make the solder bumps disclosed by Iwasaki using a leadless paste having Cu balls bonded together by Cu-Sn intermetallic compounds or using other mixtures such as Sn-Ag and Sb-Zn since this type of pastes provide a lower thermal mismatch and less internal stress and to include Cu/Sn intermetallic compounds in the solder paste disclosed by Iwasaki in view of Koning at a ratio ($\text{Cu}_6\text{Sn}_5/\text{Cu}_3\text{Sn}_6$) less than 0.65 in order to improve the electric property and heat resistance of the alloy as taught by Iino.

14. Regarding claims 22 and 23, Koning discloses that the junctions are formed by Cu balls and solder balls such as Sn balls (col. 13/lis. 31-34).

15. Regarding claim 14 Iwasaki (e.g. fig. 10) shows an electronic device comprising a semiconductor chip 91 provided with connection terminals 91a on one face, and a substrate 92 provided with connection terminals 92a on which the semiconductor terminals is connected and wires 96 bonding the connection terminals of the substrate to the connection terminals of the semiconductor chip. Also, Iwasaki discloses that another face of the semiconductor chip and the substrate are bonded to each other though bonding portions 95 (col. 2/lis.18-51).



Nonetheless, Iwasaki does not disclose that the bonding portion or adhesive means can be made from Cu balls bonded to each other by the Cu-Sn compounds including at least Cu_6Sn_5 . Koning (e.g. fig. 1) discloses an electronic device including solder paste or adhesive means 102. This paste includes Cu balls 124 bonded to each other by a Cu-Sn paste 116 (col. 3/lis. 31-34). Alternatively, the solder paste may include a Sn-Ag base solder, a Sn-Ag-Cu base solder or a Sn-Cu base solder. This type of solder paste provides a lower coefficient of thermal expansion CTE which results in a lower thermal mismatch, less internal stress during thermal cycling, and therefore a more reliable attachment (col. 3/lis. 17-19). Although Koning does not list all possible Cu-Sn intermetallic compounds it is a scientific fact that Cu/Sn intermetallic compounds include Cu_3Sn_6 and/ or Cu_6Sn_5 . For example, lino teaches that Cu_3Sn_6 and Cu_6Sn_5 are Cu-Sn intermetallic compounds. According to lino a $\text{Cu}_6\text{Sn}_5/\text{Cu}_3\text{Sn}_6$ ratio of less than 0.65 improves the electric and heat resistance properties of the alloy (col. 3/ll. 63-col. 4/ll. 34). It would have been obvious to one of ordinary skill in the art at the time the invention was made to make the bonding portion or adhesive means disclosed by Iwasaki from a solder paste having Cu balls bonded together by Cu-Sn intermetallic compounds since this type of pastes provide a lower thermal mismatch and less internal stress as taught by Koning and to include Cu/Sn intermetallic compounds in the solder paste disclosed by Iwasaki in view of Koning at a ratio ($\text{Cu}_6\text{Sn}_5/\text{Cu}_3\text{Sn}_6$) of less than 0.65 in order to improve the electric property and heat resistance of the alloy as taught by lino.

16. Regarding claim 15, Iwasaki discloses that the substrate comprises connection terminals or bumps 103 on a rear face regarding a face provide with the connection terminals. Iwasaki does not suggest that the bumps 130 can be made of one selected from the group consisting of Cu-Sn, Sn-Ag and Sn-Zn base solder. Koning discloses a leadless solder paste made of one selected from the group consisting Cu-Sn, Sn-Ag and Sn-Zn. According to Koning, this type of junction provides a lower coefficient of thermal expansion CTE which results in a lower thermal mismatch, less internal stress during thermal cycling, and therefore a more reliable attachment (col. 3/lls. 17-19). It would have been obvious to one of ordinary skill in the art at the time the invention was made to make the solder bumps disclosed by Iwasaki using a leadless paste made of one selected from the group consisting Cu-Sn, Sn-Ag and Sb-Zn Sn-Ag since this type of paste provides a lower coefficient of thermal expansion CTE which results in a lower thermal mismatch and less internal stress during thermal cycling as taught by Koning.

17. Regarding claims 25 and 26, Koning discloses that the junctions are formed by Cu balls and solder balls such as Sn balls (col. 13/lls. 31-34).

Allowable Subject Matter

18. Claims 16, 19, 21 and 24 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

Response to Arguments

19. Applicant's arguments with respect to claims 1-3, 14 and 15 have been considered but are moot in view of the new ground(s) of rejection.

Remarks

20. Claims 4-9 and 11-13 were cancelled in the amendment filed on 05/02/2003. It is respectfully noted that these claims cannot be presented and labeled as withdrawn since they are not longer pending in the present application.

Conclusion

21. Applicant's submission of an information disclosure statement under 37 CFR 1.97(c) with the fee set forth in 37 CFR 1.17(p) on 11/10/2003 prompted the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 609(B)(2)(i). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a). A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

22. Papers related to this application may be submitted directly to Art Unit 2826 by facsimile transmission. Papers should be faxed to Art Unit 2826 via the Art Unit 2826 Fax Center located in Crystal Plaza 4, room 3C23. The faxing of such papers must conform to the notice published in the Official Gazette, 1096 OG 30 (15 November

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1989). The Art Unit 2826 Fax Center number is **(703) 308-7722** or **-7724**. The Art Unit 2826 Fax Center is to be used only for papers related to Art Unit 2826 applications.

23. Any inquiry concerning this communication or earlier communications from the examiner should be directed to **Leonardo Andújar** at **(703) 308-0080** and between the hours of 9:00 AM to 7:30 PM (Eastern Standard Time) Monday through Thursday or by e-mail via Leonardo.Andujar@uspto.gov. If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nathan Flynn, can be reached on (703) 308-6601.


24. Any inquiry of a general nature or relating to the status of this application should be directed to the **Group 2800 Receptionist** at **(703) 305-3900**.

25. The following list is the Examiner's field of search for the present Office Action:

Field of Search	Date
U.S. Class / Subclass (es): 257/783, 779, 738, 772, 780, 782	12/03
Other Documentation:	
Electronic Database(s): East (USPAT, US PGPUB, JPO, EPO, Derwent, IBM TDB)	12/03

Leonardo Andújar

Patent Examiner Art Unit 2826

LA
12/23/03

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